

10. ARA-16 RADIONUCLIDE TANK

Remedial action is required for the ARA-16 Radionuclide Tank site to address the potential human health and environmental risk posed by contaminated soil and the radionuclides, toxic metals, and organics contained in the tank waste. The tank contents are classified as principal threat waste. The entire tank system will be removed to address the risk associated with contaminated soil and the threat posed by a potential release of the tank contents. The site characteristics including the nature and extent of contamination, the summary of site risks, remedial action alternatives, and the selected remedy are presented below. More detailed information about the sanitary waste system can be found in the WAG 5 Comprehensive RI/FS report (Holdren et al. 1999).

The ARA-16 site is a 3,785-L (1,000-gal) stainless steel underground holding tank resting within a lidless concrete vault and covered by approximately 1.1 m (3.5 ft) of soil. From 1959 to 1988, the tank received radioactive liquid waste, including wash water from the ARA-I hot cells, and methanol, acetone, chlorinated paraffin, and mixed acids from materials testing and research and metal-etching processes. Periodically, the contents of the tank were emptied into a tank truck and transported to the INTEC (known as the Idaho Chemical Processing Plant at that time) for disposal. The ARA-I facility was formally shut down in 1988 and the tank was partially excavated. All lines into and out of the tank were cut and capped, and the contents were agitated and pumped out, leaving a small amount of residual liquid and sludge in the tank. Soil from the excavation was replaced over the tank. The site investigations, the summary of the risk assessment, and the nature and extent of contamination for the COC are presented below. Aerial photographs of Site ARA-16 before and after the D&D of ARA-I are shown in Figure 23.

10.1 Site Investigations

Data from three investigations of the ARA-16 Radionuclide Tank contents were considered in the WAG 5 Comprehensive RI/FS (Holdren et al. 1999): the Track 1 assessment including data from the 1988 shutdown activities (Holdren 1998), sampling conducted in 1994 and reported in the WAG 5 Work Plan (DOE-ID 1997a, Appendix D), and additional characterization under the WAG 5 Work Plan reported in the RI/FS (Holdren et al. 1999). The Track 1 assessment summarized the results of the radiation surveys and procedures implemented during the 1988 shutdown of the ARA-I facility. The tank was partially excavated, all lines into and out of the tank were cut and capped, and the contents were agitated and pumped out, leaving a small amount of residual liquid and sludge in the tank. Soil from the excavation was replaced over the tank. Soil surveys conducted during partial excavation of the tank indicated beta-gamma rates between 400 to 1,000 disintegrations per minute. However, evidence about the condition of the tank was not collected and the source of the contamination was not determined. The tank contents were sampled, but radionuclides were not analyzed. Furthermore, because the tank contents were agitated before samples were collected, the two phases (liquid and sludge) were homogenized.

The contents of the tank were sampled again in 1994. Based on analytical results and process knowledge (i.e., anecdotal information), the tank waste was classified as transuranic waste (DOE-ID 1997a, Appendix D) with RCRA F-listed contaminants (40 CFR 261, Subpart D). Transuranic waste is defined as waste containing concentrations of at least 100 nCi of radioactivity per gram of waste where the radioactivity is attributed to alpha-emitting isotopes with atomic numbers greater than 92 and half-lives longer than 20 years. The transuranic radioisotopes Am-241, Pu-238, and Pu-239 were detected in the sludge in concentrations of 450 nCi/g, 330 nCi/g, and 290 nCi/g, respectively.

Additional samples were specified in the WAG 5 Work Plan (DOE-ID 1997a) to characterize the tank contents, but discrete samples of the liquid and sludge phases could not be obtained. The tank contained more liquid and less sludge than anticipated (Wilson-Lopez 1997). The 1997 analytical results

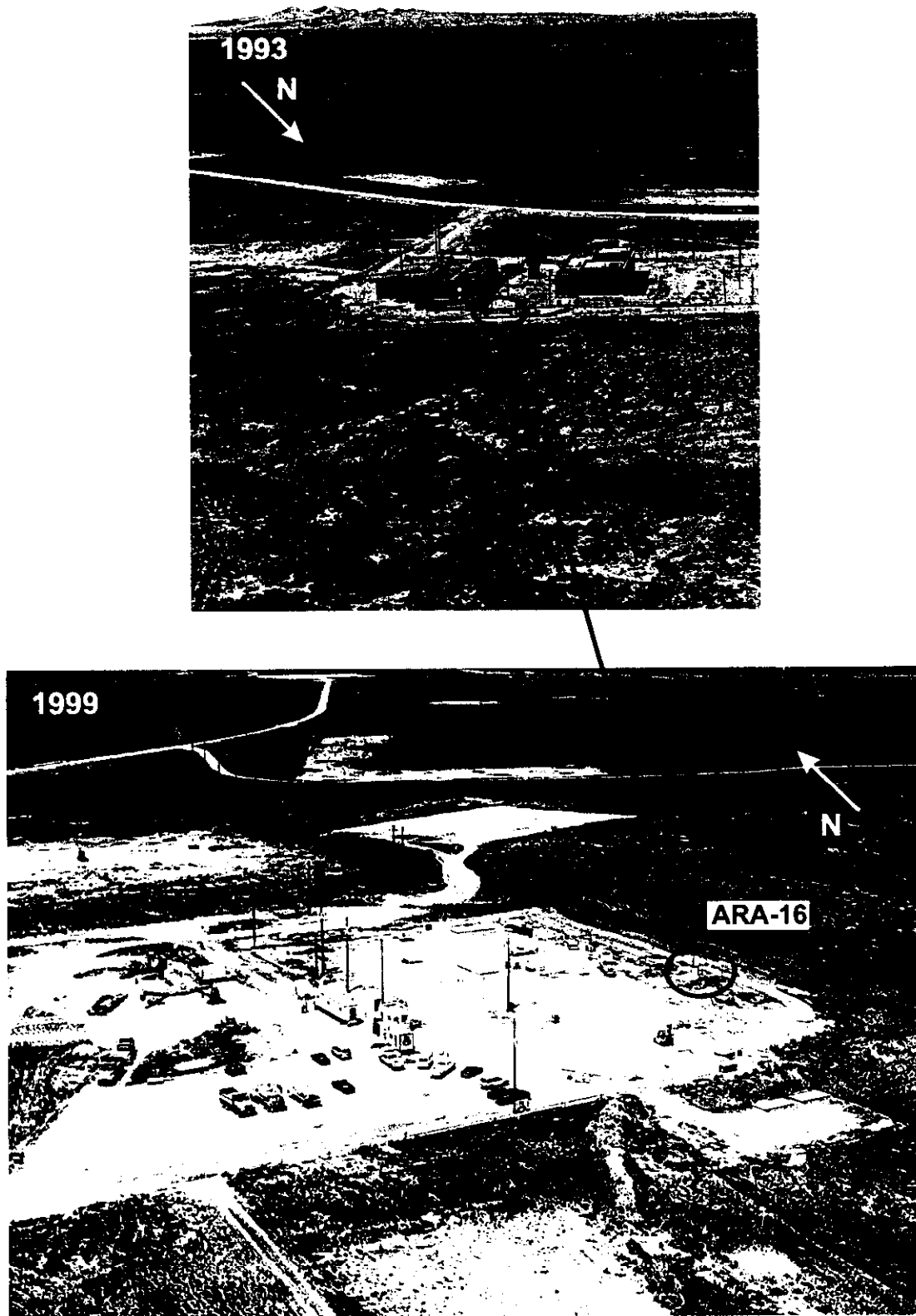


Figure 23. Aerial photographs of Site ARA-16 before and after the decontamination and dismantlement of the ARA-I facility.

are summarized in Table 26. The complete results are presented in the RI/FS report (Holdren et al. 1999, Appendix E). Based on the 1997 data, the contents of the tank are classified as RCRA F-listed mixed waste, but not as transuranic waste. The transuranic elements would be detected in higher concentrations in the sludge. Therefore, the differences between the 1994 and 1997 data are probably because of the insufficient quantity of sludge available for sampling in 1997.

Samples of the surface and subsurface soil and gravel inside the concrete vault at the ARA-16 site also were collected in 1997. Four boreholes were drilled between the tank and the walls of the vault using a hand auger, and samples were taken at the vault bottom. Field surveys of the samples showed no radionuclides above background. The samples were sent for laboratory analysis, and the results are presented in the RI/FS (Holdren et al. 1999, Appendix E; Wilson-Lopez 1997).

Outside of the vault, three boreholes were successfully drilled to varying depths. The first borehole was drilled to a depth of only 1.5 m (5 ft) before basalt was encountered and the drilling could not proceed. The second borehole was drilled to a depth of 2.6 m (8.5 ft), and the third borehole was completed to a depth of 3.1 m (10 ft). Samples were collected from the surface and at the bottom of each hole. The second and third boreholes were the only locations from which samples were retrieved below the elevation of the bottom of the vault. The samples were surveyed for radioactivity with negative results (Wilson-Lopez 1997). The samples were sent for laboratory analysis. The data are presented in the RI/FS (Holdren et al. 1999, Appendix E).

Most of the contaminants detected in the tank waste were not detected outside of the tank, which indicates that the tank has not leaked. The soil contamination in the area was probably caused originally by the cleanup of the SL-1 accident and mixed into the soil around the tank during excavation and sampling. Some contamination may have been caused by small spills as the tank was periodically emptied.

10.2 Nature and Extent of Contamination

The location of ARA-16 relative to ARA-I, the contaminant profile for Cs-137 in soil, and the source volume used in the risk assessment are illustrated in Figure 24.

10.3 Summary of Site Risks for the ARA-16 Radionuclide Tank

In accordance with the risk assessment protocol (LMITCO 1995), the contents of the tank were not quantitatively evaluated in the RI/BRA because a release to the environment has not occurred. Therefore, the risk assessment was limited to evaluating the soil outside of the tank. The site was eliminated from evaluation in the ERA. The human health risk potential from chloride, sulfate, Ag-108m, Co-60, Cs-134, Cs-137, Eu-152, Eu-154, Ra-226, and Sr-90 in soil and gravel were evaluated. Cesium-137 is the only COC identified for the ARA-16 site based on human health risks. A summary of the information about the COC in soil at ARA-16 is given in Table 27.

The total estimated risk for the 100-year future residential scenario for the soil around the tank is $1\text{E-}04$ (1 in 10,000) from Cs-137. The noncarcinogenic hazard quotient for residential exposure is less than 1.0.

The total estimated risk for all pathways for the current occupational scenario is $3\text{E-}04$. The primary component of the risk is $3\text{E-}04$ (3 in 10,000) from Cs-137, with $1\text{E-}06$ (1 in 1,000,000) from Sr-90, $1\text{E-}06$ (1 in 1,000,000) from Eu-154, $1\text{E-}06$ (1 in 1,000,000) from Eu-152, $4\text{E-}06$ (4 in 1,000,000) from Co-60, and $1\text{E-}06$ (1 in 1,000,000) from Ag-108m. The hazard index for the current occupational exposure is less than 1.0.

Table 26. Chemical and radiological characteristics of ARA-16 tank waste samples collected in 1997.

Contaminant	Liquid Phase		Sludge Phase	
	Minimum Concentration	Maximum Concentration	Minimum Concentration	Maximum Concentration
Anions (mg/L)				
Fluoride	0.826	1.91		34.3
Chloride	200	236		1,660
Bromide	0.348	0.385		
Nitrate				11.7
Phosphate	110	112		1,050
Sulfate	93.9	105		581
Total Cyanide (mg/L)	0.011	0.012		15.8
Metals				
	(µg/L)	(µg/L)	Dry/Wet (mg/kg)	Dry/Wet (mg/kg)
Aluminum	275	340.1	11,300/2,360	17,100/3,570
Antimony			11.8/2.48	12.1/2.52
Arsenic	13.4	14.1	1,180/0.766	2,650/0.760
Barium	1.6	4.6	215/44.9	329/68.8
Beryllium	0.3	0.3	5.58/1.17	9.58/2.00
Cadmium			28.5/5.97	16.7/3.50
Calcium	9,100	9,760	7,800/1630	11,500/2,390
Chromium	5.9	22.6	878/184	1,370/287
Cobalt			6.66/1.39	17.9/3.74
Copper	169	179.8	393/82.1	660/138
Iron	152	193	22,500/4,700	47,000/9,820
Lead	14.9	36.2	2,600/543	3,970/830
Magnesium	25,700	27,300	3,650/762	5,560/1,160
Manganese	7.4	7.4	103/21.4	216/45.1
Mercury	0.42	0.6	2.07/0.434	3.35/0.700
Nickel	139	147	190/39.8	407/85.0
Potassium	13,800	14,800	1,450/304	2,280/477
Selenium			4.400/0.91	5,270/1.10

Table 26. (continued).

Contaminant	Liquid Phase		Sludge Phase	
	Minimum Concentration	Maximum Concentration	Minimum Concentration	Maximum Concentration
	(µg/L)	(µg/L)	Dry/Wet (mg/kg)	Dry/Wet (mg/kg)
Silver	18.3	31.1	527/110	720/151
Sodium	243,000	253,000	3,000/628	4,390/917
Sulfur			2,040/427	3,960/827
Thallium			279/0.058	308/0.064
Vanadium	9.9	11.2	84.4/17.6	159/33.3
Zinc	46.9	56.9	586/123	890/186
Polychlorinated biphenyls	(µg/L)	(µg/L)	(µg/kg)	(µg/kg)
Aroclor-1260			52,000	98,000
Radionuclides	(pCi/L)	(pCi/L)	(pCi/g)	(pCi/g)
Ag-108m			2,480	6,800
Co-60	16,700	18,700	105,000	320,000
Cs-134	199,000	213,000	24,700	38,300
Cs-137	58,500,000	60,900,000	9,190,000	13,300,000
Eu-152			16,100	24,900
Eu-154			4,160	9,080
Zn-65			4,910	6,560
Pu-238	874	1,290	14,800	28,700
Pu-239/240	1,230	2,150	15,900	28,000
U-234	698	798	31,400	38,900
U-235		4.68		
U-238	15	16		464
Am-241	1,450	1,900	25,900	36,400
Strontium-90 (pCi/g)	162,000	172,000	455,000	638,000
Tritium (pCi/g)	290,000	301,000		
Toxicity characteristic leaching procedure volatile organic compounds	(µg/L)	(µg/L)	(µg/kg)	(µg/kg)
1,1-Dichloroethene				550
Trichloroethene				40,000

Table 26. (continued).

Contaminant	Liquid Phase		Sludge Phase	
	Minimum Concentration	Maximum Concentration	Minimum Concentration	Maximum Concentration
Volatile organic compounds	(µg/L)	(µg/L)	(µg/kg)	(µg/kg)
1,1-Dichloroethene		190		46,000
Trans-1,2-dichloroethene		7		
1,1-Dichloroethane		360		8,300
Cis-1,2-dichloroethene		53		1,300
1,1,1-Trichloroethane	60,000	63,000	19,000,000	22,000,000
Trichloroethene	13,000	13,000	3,600,000	4,500,000
Toluene		28	160,000	210,000
1,1,2-Trichloroethane		110		2,800
Tetrachloroethene		5		7,800
Ethylbenzene				4,600
M- and P-xylenes				19,000
O-xylene				6,100
1,1,2,2-Tetrachloroethane		43		3,900

ARA-I

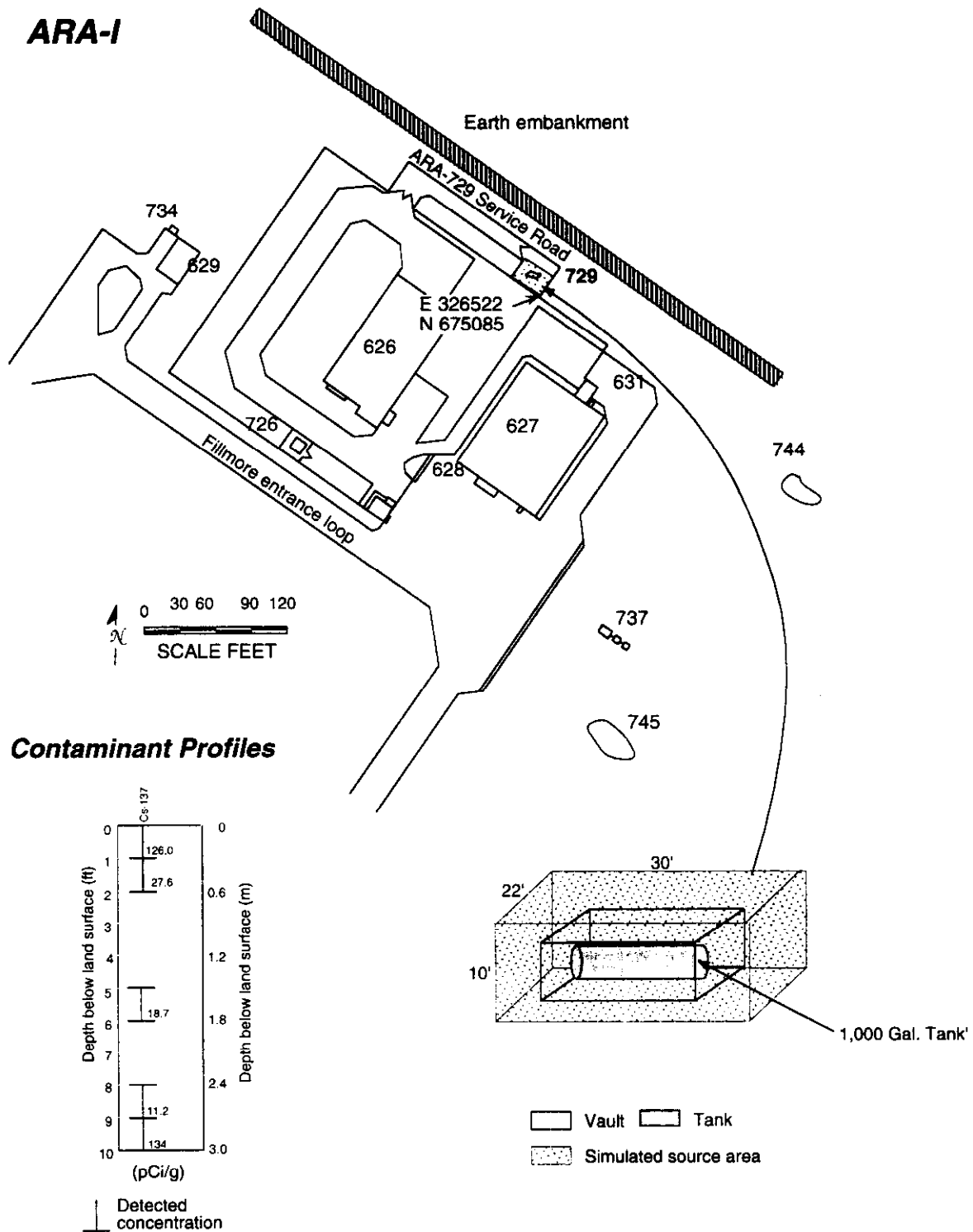


Figure 24. Site ARA-16, ARA-I radionuclide tank soil.

Table 27. Soil concentrations for the contaminant of concern^a at ARA-16.

Contaminant of Concern	Half-life (years)	Minimum Concentration (pCi/g)	Maximum Concentration (pCi/g)	Frequency of Detection	Background Concentration (pCi/g)	Exposure Point Concentration (pCi/g)	Statistical Measure
Cs-137	30	0.27	201	25/25	0.82 ^b	31.8	UCL ^c

a. Because the tank contents have not been released to the environment, the identification of contaminants of concern was limited to contaminants detected in the soil. The tank contents are described in Table 26.

b. The background value for composited samples is from Rood, Harris, and White (1996).

c. The UCL is the 95% upper confidence limit on the mean soil concentration.

The total estimated risk for all pathways for the 100-year occupational scenario is 1E-04 (1 in 10,000). The primary contributor is Cs-137. The noncarcinogenic hazard index for the future occupational exposure is less than 1.0.

10.4 Remediation Objectives for the ARA-16 Radionuclide Tank

Remediation objectives based on the unacceptable risks discussed above (Section 10.3) were developed for the soil at the ARA-16 Radionuclide. Human health risk of 1E-04 is posed primarily by external exposure to ionizing radiation from Cs-137. Dermal adsorption and ingestion of PCBs pose secondary human health risks. A summary of the risks is provided in Table 7. In addition, remediation will be applied to address the principal threat waste contained in the tank.

The human health threat posed by the radioactively contaminated soil and gravel in and around the ARA-16 tank vault is external exposure to ionizing radiation. No unacceptable ecological risk is associated with this site. The remedial action objective developed for the soil and gravel is to inhibit direct exposure to radionuclide COCs that would result in a total excess cancer risk greater than or equal to 1 in 10,000 for current and future workers and for future residents. To meet this objective, a remediation goal for Cs-137 was established (see Table 28). The goal is at the upper end of the acceptable risk range because conservative parameters were used in the risk assessment, because risk from background concentrations at the INEEL exceed 1E-06, and because EPA radiation standards, which apply to risks from exposure to radionuclides, are generally set at a risk level of 1 in 10,000.

The remediation goal can be satisfied by either cleaning up to the identified contaminant concentration (see Table 28) or by removing all contaminated media down to the basalt interface. Removing soil down to basalt will be protective because surface exposure pathways will be eliminated. The RI/FS for WAG 5 (Holdren et al. 1999) showed that groundwater exposure pathways pose a cumulative risk less than 1E-04 and a hazard index less than 1 for the baseline no action alternative. Removal of contaminated media from WAG 5 will further reduce the potential groundwater risk. Therefore, remediation to retrieve residual contamination that may have migrated into the fractured basalt would not be justified.

Though no releases have occurred from the ARA-16 tank and the tank is not leaking, the tank contents are identified as principal threat waste and could pose an unacceptable risk if released to the environment. Therefore, an additional remedial action objective was developed to prevent release of the tank contents and preclude human and ecological exposures to the ARA-16 tank contents.

Table 28. Remediation goal for the ARA-16 Radionuclide Tank site.

Contaminant of Concern ^a	Soil Concentration Remediation Goal	Derivation	Reference	Risk Scenario
Cs-137	23 pCi/g ^b	1E-04 external exposure risk	Fromm (1996)	100-year future residential

a. The ARA-16 tank is not leaking. However, the tank contents are identified as principal threat waste and could pose an unacceptable risk if released to the environment. Therefore, an additional remedial action objective was developed to prevent release of the tank contents and preclude human and ecological exposures to the ARA-16 tank contents.

b. The remediation goal for Cs-137 is equal to 100 times the 1E-06 risk-based soil concentrations reported by Fromm (1996).

The following land-use assumptions were used in development of the remedial action objectives for the ARA-16 tank:

- Institutional controls before 2095 will include current security controls, site access controls, radiological controls, and worker monitoring
- For 2095 and beyond, homes could be built anywhere within WAG 5 and the water supply well could be drilled adjacent to the home.

10.5 Description of Alternatives for the ARA-16 Radionuclide Tank

Five alternatives were considered for the ARA-16 radionuclide tank site. Alternative 2, limited action, was screened out in the feasibility study because the alternative did not meet the threshold criteria for protection of human health and the environment and compliance with ARARs. Alternative 5, removal, ex situ stabilization, and disposal, also was screened out in the feasibility study because implementation of the alternative has a high uncertainty, the final waste form is not likely to meet acceptance criteria for disposal in any approved landfill, and the cost is high. Though Alternative 1, no action, does not meet threshold criteria, it was retained for detailed analysis to serve as a baseline for comparing other remedial action alternatives.

10.5.1 Alternative 1, No Action

The no action alternative for the ARA-16 Radionuclide Tank consists of groundwater, air, and soil monitoring. No active remediation would be performed under this alternative to alter existing site conditions.

10.5.2 Alternative 3, In Situ Vitrification

Alternative 3 for the ARA-16 Radionuclide Tank consists of in situ vitrification. Alternative 3 has three variations: 3a, 3b1, and 3b2. Under Alternative 3a, the entire site, including the tank, tank contents, contaminated soil, and vault would be vitrified in situ. A soil cover would be placed over the site and monitoring would be implemented to detect any release of contaminants from the treated waste form. Alternatives 3b1 and 3b2 will not be discussed further because they are no longer viable options for the tank. Under Alternatives 3b1 and 3b2, the waste would be shipped to Test Area North where it would be treated by vitrification along with the WAG 1 V-tanks. However, since the WAG 5 Comprehensive Proposed Plan (DOE-ID 1999b) was issued, ex situ thermal treatment has been identified as a more cost-effective and practical alternative for remediation of the V-tanks at Test Area North (DOE-ID 1999a) and in situ vitrification will not be implemented. Therefore, the in situ vitrification option at Test Area North is no longer viable for the ARA-16 tank waste.

10.5.3 Alternative 4: Removal, Ex Situ Thermal Treatment, and Disposal

Alternative 4 comprises removing and shipping the ARA-16 Radionuclide Tank waste to a thermal treatment facility outside of WAG 5, disposing of the treatment residuals off the INEEL, excavating and removing the tank system, decontaminating or encapsulating the debris, and disposing of the debris either on or off the INEEL, depending on waste classification. The tank waste would be packaged in a high-integrity container for temporary storage at the RWMC until the Advanced Mixed Waste Treatment Facility (AMWTF) or another treatment facility approved for RCRA or TSCA (40 CFR 761) mixed waste, on or off the INEEL, becomes operational. The alternative incorporates the assumption that the ARA-16 tank system could be decontaminated and disposed of at the INEEL as low-level waste.

Remediation of any contaminated soil around the tank would be addressed under the contaminated soil alternatives.

10.5.4 Comparison of Elements and Distinguishing Features of Each Alternative

The relative cost and performance of each alternative is described in Table 29.

10.6 Comparative Analysis of Alternatives for the ARA-16 Radionuclide Tank

The alternatives were evaluated using the nine evaluation criteria as specified by CERCLA (40 CFR 300.43[f][5][i]). The purpose of this comparison is to identify the relative advantages and disadvantages associated with each alternative. The comparative analyses of alternatives for the nine criteria are summarized below.

10.6.1 Overall Protection of Human Health and the Environment

For the ARA-16 radionuclide tank, Alternative 1, no action, would not be protective of human health and the environment. Alternative 4, excavation, ex situ thermal treatment, and disposal, would provide the highest degree of long-term protection of human health and the environment because the contaminated media would be removed from WAG 5, treated, and disposed of in an approved facility. Of the three alternatives, Alternative 3a would provide the least protection within WAG 5 because the vitrified tank site would remain at ARA-I. Moreover, the soil cover over the vitrified waste form has less long-term effectiveness than the vitrified waste form itself. Therefore, direct exposure to radiation could be a risk in the future.

10.6.2 Compliance with ARARs and TBCs

The ARARs for Alternative 1, no action, would not be met for ARA-16. Alternatives 3a, in situ vitrification, and 4, removal, ex situ thermal treatment, and disposal, for the ARA-16 tank would meet ARARs.

10.6.3 Long-Term Effectiveness and Permanence

Of the three retained ARA-16 alternatives, Alternative 1, no action, would provide the least long-term effectiveness and permanence for the ARA-16 site. Alternative 4, excavation, ex situ thermal treatment, and disposal, would provide the highest degree of long-term effectiveness and permanence because the waste would be removed from WAG 5. Alternative 3a would provide less protection within WAG 5 because the vitrified tank site would remain at ARA-I. Moreover, the soil cover of the vitrified waste form has less long-term effectiveness than the vitrified waste form itself. Therefore, direct exposure to radiation could be a risk in the future.

10.6.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

For Alternatives 3a and 4, the waste would be treated to reduce toxicity, mobility, and volume. The two alternatives are considered equivalent relative to this criterion.

10.6.5 Short-Term Effectiveness

Of the retained ARA-16 alternatives, Alternative 1, no action, would be the most effective in the short term because no actions resulting in additional worker exposure would occur. No off-Site exposures

Table 29. Detailed analysis summary of remediation alternatives for the ARA-16 Radionuclide Tank site.

Criteria	Alternative 1 No Action	Alternative 3a In Situ Vittrification at ARA-I	Alternative 4 Removal, Ex Situ Thermal Treatment, and Disposal
Overall protection of human health and the environment			
Human health protection	No reduction in risk.	Would eliminate potential exposure to waste by eliminating exposure pathways.	Would eliminate potential exposure to waste by removing contamination from WAG 5.
Environmental protection	Would allow continued ecological exposures and risk of tank waste release.	Would eliminate potential exposure to waste by eliminating exposure pathways.	Would eliminate potential ecological exposure to waste by removing contamination from WAG 5.
Compliance with applicable, relevant, and appropriate requirements (ARARs)			
Action-specific			
Idaho Hazardous Waste Management Act—IDAPA 16.01.05.006, .008, and .011	Would not meet ARAR.	Would meet ARAR.	Would meet ARAR.
Resource Conservation and Recovery Act—40 CFR 262, 264, and 268	Would not meet ARAR.	Would meet ARAR.	Would meet ARAR.
Toxic Substance Control Act—40 CFR 761	Would not meet ARAR.	Would meet ARAR.	Would meet ARAR.
Idaho Fugitive Dust Emissions—IDAPA 16.01.01.650 through .651	Not applicable	Would meet ARAR through use of engineering controls.	Would meet ARAR through use of engineering controls.
Rules for Control of Air Pollution in Idaho—IDAPA 16.01.01.210, and IDAPA 16.01.01.585 through .586:	Not applicable	Would meet ARAR through use of engineering controls.	Would meet ARAR through use of engineering controls.
NESHAP—40 CFR 61.92 and .93	Would meet ARAR because waste is not a source of air emissions.	Would meet ARAR through use of engineering controls.	Would meet ARAR through use of engineering controls.
Chemical-specific			
Idaho Ground Water Quality Rule—IDAPA 16.01.11.200	Would not meet ARAR.	Would meet ARAR by immobilizing contamination and monitoring for releases.	Not applicable
Location-specific			
Rules for Control of Air Pollution in Idaho—IDAPA16.01.01.581	Not applicable	Would meet ARAR through use of engineering controls.	Would meet ARAR through use of engineering controls.
Native American Graves Protection and Repatriation Act —25 USC 32	Would meet ARAR.	Would meet ARAR through surveys and assessments and actions deemed necessary.	Would meet ARAR through surveys and assessments and actions deemed necessary.
National Archeological and Historic Preservation Act—36 CFR 800	Would meet ARAR.	Would meet ARAR through surveys and assessments and actions deemed necessary.	Would meet ARAR through surveys and assessments and actions deemed necessary.
To be considered (TBC)			
Radiation Protection of the Public and Environment—DOE Order 5400.5	Would not meet TBC because no controls would be implemented.	Would meet TBC through use of engineering and institutional controls and best management practices.	Would meet TBC through use of administrative controls.

Table 29. (continued).

Criteria	Alternative 1 No Action	Alternative 3a In Situ Vittrification at ARA-I	Alternative 4 Removal, Ex Situ Thermal Treatment, and Disposal
Long-term effectiveness and permanence			
Magnitude of residual risk	No change from existing risk.	Would eliminate source-to-receptor pathways.	No residual risk would remain at WAG 5.
Adequacy and reliability of controls	No control and, therefore, no reliability.	The vitrified waste form is estimated to provide reliable control over contaminants in waste for hundreds of years.	Disposal facility for treated waste, contaminated soil, and debris is assumed to provide adequate and reliable control for the period of institutional control.
Reduction of toxicity, mobility, or volume through treatment			
Treatment process used	Not applicable	In situ vittrification	Incineration
Amount destroyed or treated	Not applicable	Approximately 100%	Approximately 100%
Reduction of toxicity, mobility, or volume	Not applicable	40 to 50% volume reduction, 100% mobility reduction, and 50% toxicity reduction.	50 to 80% volume reduction, 70% mobility reduction, and 50% toxicity reduction.
Irreversible treatment	Not applicable	Not reversible, but would afford long-term stability.	Not reversible, but would afford long-term stability.
Type and quantity of residuals remaining after treatment	Not applicable	Vitrified waste form, decontamination fluids, used personal protective equipment.	No waste would be left at WAG 5. A vitrified mass, decontamination fluids, and used personal protective equipment would remain after treatment of the tank waste.
Statutory preference for treatment	Not applicable	Meets preference.	Meets preference.
Short-term effectiveness			
Community protection	Would not increase potential risks to the public.	Would not increase potential risks to the public.	Would be slight increase in potential risks to the public during off-Site transportation.
Worker protection	Not applicable	Workers would be protected by extant engineering and administrative controls.	Workers would be protected by engineering and administrative controls.
Environmental impacts	No change from existing conditions.	Limited to site preparation required for in situ vittrification. Limited potential for airborne contamination.	Limited to disturbances from vehicle and material transport activities associated with excavation of the tank. If required, use of containment systems with high-efficiency particulate air filtration and dust suppressants would significantly limit the potential for airborne contamination.
Time until action is complete	Not applicable	Approximately 18 to 24 months	Approximately 18 to 24 months

Table 29. (continued).

Criteria	Alternative 1 No Action	Alternative 3a In Situ Vitrification at ARA-1	Alternative 4 Removal, Ex Situ Thermal Treatment, and Disposal
Implementability			
Ability to construct and operate	No construction or operation.	Moderately difficult; involves proprietary technology.	Moderate because of radiation protection requirements. Uses available construction technology.
Ease of implementing additional action if necessary	Could require repeat of feasibility study and record of decision process.	Moderately difficult. The relatively small volume of vitrified waste could be excavated, removed, and disposed of if required.	Easy. Residues from the tank waste could be stabilized.
Ability to monitor effectiveness	Monitoring of conditions would be readily implemented.	The effectiveness in vitrifying all contaminants would be easily monitored.	Sampling of waste residues to verify treatment performance would be easily performed.
Ability to obtain approvals and coordinate with regulatory agencies	No approvals required.	Difficult because of the presence of RCRA- and TSCA-regulated components in the waste. ARAR waivers would be required.	Relatively easy
Availability of services and capacity	None required.	Services for in situ vitrification at ARA-16 would be available through a subcontractor.	Services would be available at the INEEL.
Availability of equipment, specialists, and materials	None required.	Equipment and materials to perform in situ vitrification at ARA-16 would be available through a subcontractor.	Equipment and materials would be available either at the INEEL or through subcontractors, or will be purchased.
Availability of technology	None required.	Available commercially.	Available at the INEEL.
Cost (net present value, 5% discount rate)			
Capital Cost	\$1.6 million	\$3.6 million	\$4.4 million
Operations and Maintenance Cost	\$7.7 million	\$5 million	NA
Total Cost	\$ 9.3 million	\$ 8.6 million	\$ 4.4 million
a. Details of the cost estimates are provided in the WAG 5 Comprehensive RI/FS report (Holdren et al. 1999, Appendix K).			

would occur because the site is not located near inhabited areas and no public roads are in the vicinity. No additional environmental impacts would result from this alternative other than those resulting from the extant conditions. Under Alternative 4, removal, ex situ thermal treatment, and disposal, the contaminated soil would be excavated and removed and the tank waste would be transferred into another container, which would result in the highest risk for exposure. Therefore, this alternative is considered the least effective for short-term protection for the ARA-16 tank site. Alternative 3a is considered the most effective for the tank site because direct exposure to ARA-16 tank contents would be avoided.

10.6.6 Implementability

Each of the three alternatives retained for detailed analysis is technically implementable for ARA-16. Alternative 1, no action, would be the most implementable for ARA-16 because it would require no change in extant site conditions.

Alternative 4, removal, ex situ thermal treatment, and disposal, is more implementable than Alternative 3 for the ARA-16 radionuclide tank. The existing facilities for storage of ARA-16 waste are adequate, and the necessary equipment and methods for treatment under Alternative 4 are currently under construction at the ATG, Inc. (ATG) facility in Richland, Washington, and construction of the AMWTF is planned.

Alternative 3a is considered less implementable because in situ vitrification of a buried mixed waste tank has not been demonstrated.

10.6.7 Cost

Alternative 4, removal, ex situ thermal treatment, and disposal, is the least costly alternative for the ARA-16 tank site. Alternative 3a is nearly twice as costly as Alternative 4 because of the large capital expense required to implement in situ vitrification, construct the soil cover, and install the monitoring system, and the significant operations and maintenance costs to maintain the site and perform monitoring for the period of institutional controls. Alternative 1, no action, is the most expensive of the three alternatives because of the monitoring that would be performed until the end of the period of institutional controls.

10.6.8 State Acceptance

The IDHW has been involved in the development and review of the OU 5-12 Comprehensive RI/FS report (Holdren et al. 1999), the Proposed Plan (DOE-ID 1999b), and this ROD. All comments received from IDHW on these documents have been resolved and the documents revised accordingly. In addition, IDHW has participated in public meetings where public comments and concerns have been received and responses offered. The IDHW concurs with the selected remedial alternative for the ARA-16 Radionuclide Tank contained in this ROD and is a signatory to the ROD with DOE and EPA.

10.6.9 Community Acceptance

Community participation in the remedy selection process and Proposed Plan reviews included participation in the public meetings held May 17 through 19, 1999 (see Section 3). The 30-day public comment period was May 10, 1999, through June 9, 1999. The Responsiveness Summary, presented as Part 3 of this ROD, includes verbal and written comments received from the public and the DOE responses to these comments. Representatives of the EPA and IDHW assisted in the development of the responses.

All comments received on the Proposed Plan were considered during the development of this ROD. Comments were raised on the validity of some sample data sets. However, the public was supportive of the preferred alternative for the ARA-16 Radionuclide Tank and generally was in agreement that removal of the radiologically contaminated waste system is required to protect human health and the environment.

10.7 Selected Remedy for the ARA-16 Radionuclide Tank, Alternative 4, Removal, Ex Situ Thermal Treatment, and Disposal

The selected remedy for the ARA-16 site is Alternative 4, removal of the ARA-16 Radionuclide Tank waste and shipment for ex situ thermal treatment and disposal. This remedy was selected based on the results of the comparative analysis of alternatives. Alternative 4 is the least costly alternative that meets threshold criteria (i.e., provides overall protection of human health and the environment and satisfies ARARs) and is easily implemented. The long-term effectiveness is high for Alternative 4 because contamination will be permanently removed from the site and treated to reduce toxicity, mobility, and volume. The estimated time required to complete remediation is 18 to 24 months. Specifically, Alternative 4 will consist of the following activities:

- Removal of waste from the tank, transfer to a high-integrity container, shipment to the RWMC for storage, treatment in a facility approved for RCRA or TSCA mixed waste, and disposal of residuals at the ICDF, if waste acceptance criteria are satisfied, another INEEL facility, or the Waste Isolation Pilot Plant, depending on post-treatment characterization results
- Excavation of the tank and vault
- Shipment of soil with Cs-137 concentrations exceeding the remediation goal (see Table 28) to the ICDF or another INEEL facility in conjunction with the soils from the contaminated soil sites (see Section 8)
- Decontamination of the tank and associated piping and disposal at the RWMC, ICDF, or another approved facility on the INEEL
- Treatment of decontamination fluids at WERF and disposal of the residuals and other secondary waste generated during remediation at an approved facility such as Envirocare
- Additional sampling of the decontamination fluids, the vault, tank, and associated piping for waste designation and to demonstrate that waste can meet waste acceptance criteria for treatment or disposal
- Dust control and environmental monitoring during active remediation
- Restoration of the site.

The ARA-16 tank contains approximately 17 L (4.5 gal) of sludge and 1,180 L (312 gal) of liquid waste (Coveleskie 1999). The waste contains high concentrations of radionuclides, toxic metals, and organics, including PCBs. Based on sampling results and process knowledge, the waste is considered low-level radioactive mixed waste and RCRA-listed waste. The associated RCRA waste codes are F001 because of concentrations of trichloroethylene, methylene chloride, and 1,1,1 trichloroethane, and F005 because of concentrations of toluene. In addition, the waste is classified as RCRA characteristic waste for trichloroethylene. Aroclor-1260 was detected at 98 ppm in the sludge; hence the waste also is regulated

under TSCA. If required by engineering studies conducted during the remedial design phase, a temporary structure equipped with shielding and a negative pressure ventilation system exhausted through high-efficiency particulate air filters will be erected over the site prior to removal of the tank waste and tank system.

The tank waste will be removed using technologies such as jetting and pumping or vacuum removal and packaged in high-integrity containers for storage at the RWMC until an acceptable treatment facility on or off the INEEL becomes operational. To be acceptable, the facility must be (1) approved for treatment of RCRA and TSCA mixed waste, (2) capable of treating all of the tank waste to satisfy RCRA land disposal restrictions, and (3) able to satisfy TSCA requirements for PCB disposal.

Two treatment facilities that will satisfy these requirements have been identified; the AMWTF at the INEEL, and the ATG mixed waste treatment facility at Richland. The AMWTF and the ATG facility are obtaining RCRA and TSCA permits. Both facilities will use high-temperature thermal processes to destroy organics, including PCBs, to meet the RCRA land disposal regulations for organics and the TSCA PCB disposal criteria. The AMWTF incinerator ash will be mixed with grout, resulting in a final waste form that meets RCRA criteria for heavy metals and immobilizes radionuclides. The final waste form from the ATG system is a nonleachable glass that also will satisfy RCRA criteria for heavy metals and immobilize radionuclides.

Excavation and removal of the structural components of the tank system will require use of conventional excavation equipment such as backhoes and front-end loaders and hand digging. During excavation, real-time gamma surveys will be used to delineate the extent of contamination and allow segregation of contaminated soil from uncontaminated soil. The contaminated soil will be disposed of in conjunction with the remediation of the contaminated soil sites as described in Section 8. Uncontaminated soil will be returned to the excavation site.

The ARA-16 tank and associated piping will be decontaminated in accordance with TSCA and RCRA decontaminating standards and procedures to the extent possible. Sampling will be performed to determine whether the RCRA clean debris standard is met. Because the tank and pipes are stainless steel, it is assumed that these materials can be cleaned to meet criteria for disposal as non-RCRA regulated low-level radioactive debris at the RWMC, the ICDF, or other disposal facility on the INEEL. Encapsulation of the tank and pipes will be performed only if required to meet the waste acceptance criteria of the disposal facility. The decontamination residue will be treated at WERF, and the residuals will be disposed of at a permitted disposal facility off the INEEL such as Envirocare.

Previous sampling results indicate that the ARA-16 tank has not leaked (Holdren et al. 1999). Therefore, the remedy incorporates the assumption that the vault and the gravel within the vault can be disposed of at the INEEL as low-level waste. The most likely location for disposal of the vault and gravel is either the RWMC or the ICDF.

Current radiological and industrial hygiene control practices will be used to reduce worker exposure to radioactive and toxic materials. Radiological controls could consist of limiting the amount of time an operator can work in the area, requiring personnel to wear personal protective clothing, and imposing distance and shielding limits to reduce radiation exposure. Industrial hygiene controls could include use of personal protective clothing to prevent dermal exposure to contaminants and respirators to prevent inhalation of toxic substances. Air emissions will be controlled by the use of water sprays or soil fixatives to suppress dust during soil excavation and removal.

Following removal of the ARA-16 tank system, the excavated site will be backfilled with uncontaminated soil, compacted, and vegetated in accordance with INEEL guidelines (DOE-ID 1989).

10.7.1 Estimated Cost for the Selected Remedy

The estimated cost for implementing Alternative 4 is \$4.4 million. Details of the cost estimate are provided in Table 30.

10.7.2 Estimated Outcomes of the Selected Remedy

Cleanup to meet the remedial action objectives and the remediation goal (see Table 28) for the ARA-16 site can be achieved by removal of contaminated soil; removal, treatment, and disposal of the tank waste; and decontamination and disposal of the tank system within 24 months after remediation is started. Cleanup to the remediation goal for soil and removal and treatment of the tank waste and removal and disposal of the tank system will provide protection of future workers and residents. Institutional controls will provide protection of current workers. Continued industrial use is projected for the ARA (DOE-ID 1996a). The complete removal of all soil contaminated at concentrations exceeding the remediation goal for Cs-137, the structural components of the ARA-16 tank system, and the tank waste will make the ARA-16 site suitable current and future industrial use, as well as residential use after the 100-year institutional control period assumed for the risk assessment.

10.8 Statutory Determinations for the ARA-16 Radionuclide Tank

10.8.1 Overall Protection of Human Health and the Environment

The selected remedy, Alternative 4, removal, ex situ thermal treatment, and disposal, will provide highly effective, long-term protection of human health and the environment. Removal of contaminated soil, the tank waste, and tank system will eliminate potential long-term risks from exposure or contaminant migration. Treatment of the ARA-16 tank waste in a treatment facility approved for RCRA or TSCA mixed waste will destroy toxic organics including PCBs and reduce the volume of waste. Envirocare, the ICDF, the RWMC, the Waste Isolation Pilot Plant, or another approved disposal facility would provide long-term isolation of the treated waste, vault, and decontaminated tank system components.

Alternative 4 is protective of the environment during implementation because mitigative measures to prevent contaminant migration during excavation activities would be implemented. Short-term protection of human health is only moderate because workers could receive exposure to the tank waste, contaminated structures of the tank system, and contaminated soil during remediation. However, risks during implementation will be managed through administrative and engineering controls. Additional waste generated during remediation will consist only of small quantities of decontamination fluids and discarded personal protective clothing and equipment. Therefore, Alternative 4 meets specified remedial action objectives and provides overall protection of human health and the environment.

10.8.2 Compliance with ARARs and TBCs

The ARARs and TBCs for Alternative 4 are presented in Table 31. As shown in the table, the substantive requirements of RCRA and IDAPA ARARs specific to hazardous waste and the TSCA ARAR specific to PCB-contaminated waste in the ARA-16 tank waste will be met. Compliance with emissions ARARs would be ensured by using dust suppression techniques during construction and excavation. Controlling the off-gases generated during the thermal treatment process will be the responsibility of the treatment vendor and is not relevant to actions conducted within WAG 5. The sites will be surveyed for cultural and archeological resources and appropriate actions taken to satisfy ARARs protection of sensitive resources. The TBC DOE Order 5400.5 would be met through administrative and engineering controls to limit exposures to allowable levels.

Table 30. Cost estimate summary for the ARA-16 Radionuclide Tank site selected remedy.

Planned Activity		Cost (Fiscal Year 1998 dollars)
FFA/CO Management and oversight		
	WAG 5 management	375,000
Remedial design		
	Remedial design/remedial action scope of work	54,000
	Remedial action work plan	63,000
	Packaging, shipping, transportation documentation	48,000
	Remedial action report	48,000
	Data collection and management for first 5-year review	141,000
	Safety analysis documentation	101,000
	Sampling and analysis plan	108,000
	Pre-final inspection report	8,000
	Legal review	32,000
	Total title design package	287,000
	Site characterization	20,000
Remedial action—construction subcontract		
	Construction subcontract	1,977,000
Project construction management		400,000
CAPITAL COST SUBTOTAL		3,662,000
	Contingency @ 30%	1,099,000
TOTAL CAPITAL COST IN FISCAL YEAR 1998 DOLLARS		4,761,000
TOTAL CAPITAL COST IN NET PRESENT VALUE		4,422,000
Operations		
	Program management	NA
	Data collection and management for 5-year reviews	NA
	Maintenance	NA
	Decontamination and dismantlement	NA
	Surveillance	NA
OPERATIONS AND MAINTENANCE COST SUBTOTAL		NA
	Contingency @ 30%	NA
TOTAL OPERATIONS AND MAINTENANCE COST IN FISCAL YEAR 1998 DOLLARS		NA
TOTAL OPERATIONS AND MAINTENANCE COST IN NET PRESENT VALUE		NA
TOTAL PROJECT COST IN NET PRESENT VALUE		4,422,000

Table 31. ARARs and TBCs for the selected alternative—removal, ex situ thermal treatment, and disposal—for the ARA-16 Radionuclide Tank site.^a

Category	Citation	Reason	Relevancy ^b
Action-specific applicable, relevant, and appropriate requirements (ARARs)			
Rules for the Control of Air Pollution in Idaho	Toxic Substances IDAPA 16.01.01.161	The release of carcinogenic and noncarcinogenic contaminants into the air must be estimated before construction begins, controlled, if necessary, and monitored during excavation of soil, removal of the waste and tank system, and decontamination of the tank and piping in accordance with state standards.	A
	Toxic Air Emissions IDAPA 16.01.01.585 and .586		
	Fugitive Dust IDAPA 16.01.01.650 and .651		
	Requirements for Portable Equipment IDAPA 16.01.01.500.02	Portable equipment for removal of the waste, tank, vault and piping, and any portable support equipment must be operated to meet state and federal air emissions rules.	A
National Emission Standards for Hazardous Air Pollutants (NESHAP)	Radionuclide Emissions from DOE Facilities 40 CFR 61.92	Exposure of radioactive contamination release is limited to 10 mrem/year for the off-Site receptor, and emissions and emission monitoring must comply with NESHAP requirements.	A
	Emission Monitoring 40 CFR 61.93		
	Emission Compliance 40 CFR 61.94(a)		
Resource Conservation and Recovery Act—Standards Applicable to Generators of Hazardous Waste	Hazardous Waste Determination IDAPA 16.01.05.006 (40 CFR 262.11)	A RCRA hazardous waste determination is required for the waste, vault, tank, piping, and any secondary waste generated during remediation, which is to be treated or disposed of on the INEEL.	RA

Table 31. (continued).

Category	Citation	Reason	Relevancy ^b
Resource Conservation and Recovery Act—Standards for Owners and Operators of Hazardous Waste Treatment Storage and Disposal Units	General Waste Analysis IDAPA 16.01.05.008 (40 CFR 264.13 (a)(1–3))	RCRA analysis requirements apply to the waste, tank, vault, and piping, and secondary waste generated during remediation.	A
	General Inspections IDAPA 16.01.05.008 (40 CFR 264.15)	In accordance with RCRA, regular inspections must be performed during remediation.	A
	Preparedness and Prevention IDAPA 16.01.05.008 (40 CFR 264 Subpart C)	Soil excavation, waste and tank system removal, and decontamination activities must comply with RCRA requirements.	A
	Contingency Plan and Emergency Procedures IDAPA 16.01.05.008 (40 CFR 264 Subpart D)	Soil excavation, waste and tank system removal, and decontamination activities must comply with RCRA requirements.	A
	Equipment Decontamination IDAPA 16.01.05.008 (40 CFR 264.114)	All equipment used during remediation must be decontaminated in accordance with RCRA requirements if hazardous waste is contacted.	A
	Use and Management of Containers IDAPA 16.01.05.008 (40 CFR 264.171 – 177)	Waste, tank, vault, piping, and any secondary hazardous waste generated remediation must be managed in accordance with RCRA requirements.	A
	Tank Closure and Post Closure Care IDAPA 16.01.05.008 (40 CFR 264.197(a))	Closure of waste, tank, vault, and piping must be conducted in accordance with RCRA requirements.	A

Table 31. (continued).

Category	Citation	Reason	Relevancy ^b
Resource Conservation and Recovery Act—Land Disposal Restrictions	Treatment Standards IDAPA 16.01.05.011 (40 CFR 268.40 (a)(b)(e))	The waste, tank, vault, and piping must be treated, if necessary, to meet RCRA land disposal restrictions criteria before disposal.	A
	Treatment Standards for Hazardous Debris IDAPA 16.01.05.011 (40 CFR 268.45 (a – d))		A
	Universal Treatment Standards IDAPA 16.01.05.011 (40 CFR 268.48 (a))		A
National Oil and Hazardous Substances Pollution Contingency Plan – Hazardous Substance Response	Procedures for Planning and Implementing Off Site Response Actions 40 CFR 300.440	Applies to all waste treated or disposed of off the INEEL.	A
Toxic Substance Control Act (TSCA)—Polychlorinated Biphenyls	PCB Remediation Waste: Performance-based disposal 40 CFR 761.61 (b)(1)	The tank waste must be treated or decontaminated to meet TSCA polychlorinated biphenyl (PCB) -disposal criteria.	A
	Decontamination Standards and Procedures : Self-implementing decontamination procedures 40 CFR 761.79 (c) (1) and (2)	The tank, piping, and equipment that come into contact with the tank waste must be decontaminated in accordance with TSCA requirements.	A
	Decontamination solvents 40 CFR 761.79 (d)	Solvents used for decontamination must be managed in accordance with the TSCA.	A
	Limitation of exposure and control of releases 40 CFR 761.79 (e)	TSCA exposure limits apply to all persons conducting decontamination activities of the ARA-16 tank and piping.	A
	Decontamination waste and residues 40 CFR 761.79 (g)	Waste and residuals must be decontaminated in accordance with the TSCA.	A

Table 31. (continued).

Category	Citation	Reason	Relevancy ^b
Location-specific ARARs			
National Historic Preservation Act	Historic properties owned or controlled by Federal agencies 16 USC 470 h-2	In accordance with federal requirements, the site must be surveyed for cultural and archeological resources before construction and appropriate actions must be taken to protect any sensitive resources.	A
	Identifying Historic Properties 36 CFR 800.4		
	Assessing Effects 36 CFR 800.5		
Native American Graves Protection and Repatriation Act	Custody 25 USC 3002 (43 CFR 10.6)	In accordance with federal requirements, the site must be surveyed for cultural and archeological resources before the commencement of construction and appropriate actions must be taken to protect any sensitive resources.	A
	Repatriation 25 USC 3005 (43 CFR 10.10)		
To be considered guidance (TBC)			
Radiation Protection of the Public and the Environment	DOE Order 5400.5, Chapter II (1)(a, b)	The order specifies limits on the effective dose to the public from exposure to radiation sources and airborne releases.	

a. The selected remedy for ARA-16 focuses on the waste and tank system. Contaminated soil will be addressed in conjunction with the remediation of the contaminated soil Site ARA-23 discussed in Section 8.

b. A = Applicable; RA = Relevant and appropriate.

10.8.3 Cost Effectiveness

Alternative 4, removal, ex situ thermal treatment, and disposal, is the least costly remediation option for ARA-16 that satisfies threshold criteria. When compared to other potential remedial actions, the selected remedy provides the best balance between cost and effectiveness in protecting human health and the environment.

10.8.4 Use of Permanent Solutions and Alternative Treatment Technologies

The selected remedy provides a permanent solution because the soil with contaminant concentrations exceeding the Cs-137 remediation goal, the tank waste, and tank system components will be permanently removed. The tank contents are principal threat wastes as defined by EPA guidance (EPA 1999a). The tank waste will be treated to reduce contaminant toxicity, mobility, and volume and disposed of in a facility outside of WAG 5 designed for long-term isolation and protection. In addition, the tank and associated piping will be decontaminated and disposed of in an equally protective facility outside of WAG 5. Because the tank vault is concrete and thus porous, decontamination of the surfaces is not practical. Therefore, the vault will be disposed of as low-level waste at the RWMC, the ICDF, or another INEEL facility.

Some soil may be left in place with residual Cs-137 contamination; therefore, minimal monitoring and maintenance may be required during the 100-year period of institutional control. After the 100-year period, the Cs-137 will have decayed to below risk-based levels for residential use of the site.

10.8.5 Preference for Treatment as a Principal Element

The selected remedy, Alternative 4, removal, ex situ thermal treatment, and disposal, prescribes treatment of the ARA-16 tank waste in a treatment facility approved for RCRA or TSCA mixed waste and decontamination of the tank and associated piping to a clean debris standard (40 CFR 268.45). Therefore, the selected alternative satisfies the preference for treatment as a principal element of the selected remedy.

10.8.6 Five-Year Reviews

Five-year reviews will be conducted for all sites with institutional controls. Land use will be restricted at ARA-16 until remediation is implemented as prescribed in this ROD. Land-use controls will not be required after remediation if all contaminated soil is removed to basalt or if contaminant concentrations are comparable to local background values. Otherwise, institutional controls will be maintained until discontinued based on the results of a 5-year review.